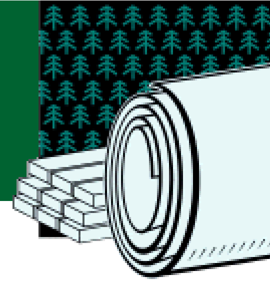
FOREST PRODUCTS
Project Fact Sheet



MOISTURE DISTRIBUTION AND FLOW DURING DRYING OF WOOD AND FIBER

BENEFITS

- Potential savings of 1 million Btus of energy per thousand board feet of production
- Fewer defects with reduced drying times, minimizing waste and facilitating further processing of wood into products
- Considerable cost savings to the industry
- Reduced production of volatile organic compounds (VOCs)

APPLICATIONS

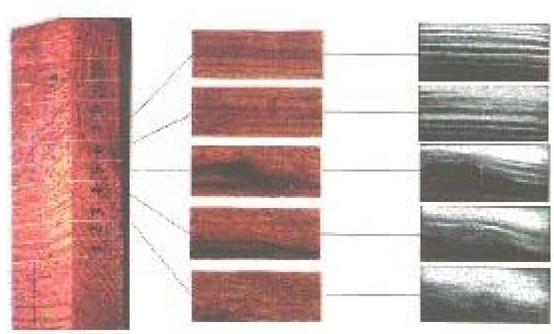
Information on the flow rate and direction, location, concentration, and gradient character of moisture in wood would be applied across the forest product industry. Operators will be able to modify their kiln schedules to optimize drying times and avoid conditions that give rise to defects in the product. In particular, the information will improve wafer drying for the manufacture of oriented strandboard, and enhance water removal in paper manufacturing. This project is a unique opportunity to apply state-of-the-art technology and expertise to enhance the efficiency and economy of the lumber industry.

A Fundamental Understanding of the Drying Process Will Reduce Energy Use in Commercial Lumber Drying Operations

The kiln drying of wood and fiber is widely practiced in the United States. In 1994, approximately 5 billion board feet of hardwood lumber and 24 billion board feet of softwood lumber were put through this very energy-intensive process. In fact, about 70 percent of the energy used in the manufacturing of lumber is dedicated to reducing the moisture content of green lumber of 80 to 90 percent or more, to about 6 percent. The forest products industry has determined that 4 to 6 billion Btus of energy are consumed for every thousand board feet of green lumber dried. This is equivalent to the use of 4,000 to 6,000 ft^3 of natural gas, or 25-38 gallons of fuel oil, and represents a considerable expense to the industry.

Although drying enhances the properties and marketability of wood products, it poses some risk to wood quality and value. Manufacturers presently prolong their drying schedules to avoid surface and internal defects; more knowledge of the fundamental mechanisms of the drying process will help determine the conditions under which defects arise. However, limitations in existing analytical and measurement techniques make it extremely difficult to measure moisture distribution and gradients in wood. Several advanced analytical tools will be used to measure the actual distribution and flow of moisture in wood and fiber samples. The results will help improve the drying process and reduce drying times and energy consumption.

MRI SCANS OF WATER IN WOOD



White areas in the right side of the illustration indicate water concentration and distribution in five sections of a lumber sample.

PROJECT DESCRIPTION

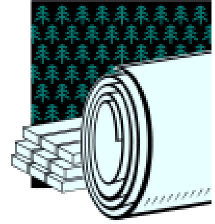
The goal of this project is to determine the distribution, gradient character, and flow of moisture in solid wood, flakes, and wood fiber, and apply this information to water removal in forest-products manufacturing processes. These variables will be studied in all three of the major types of wood:ring porous hardwood, diffuse porous hardwood, and a softwood. Historically, it has been difficult to measure moisture gradients and movement without heating and destroying the wood samples. Preliminary work by the investigators has shown that several new microscopic.analytical tools can obtain precise information while keeping the specimens intact.

These state-of-the-art research tools include magnetic resonance imaging (MRI), which will be used to measure the concentration and distribution of hydrogen protons in solid wood and wood wafers. Environmental Scanning Electron Micropsy (ESEM) will be used to measure the water and water flow in the samples under simulated drying conditions. Dimensional changes in the samples as they undergo drying will be determined by Confocal Laser Scanning Micropsy (CLSM). This procedure will also detect the origin and propagation of drying defects and construct three-dimensional images of the drying process. Finally, Atomic Force Micropsy (AFM) will be used to demonstrate the forces associated with moisture sorption and flow.

Following the experimental phase of the project, mill trials will be conducted at the facilities of some of the project partners.

PROGRESS & MILESTONES

- Data from the experimental measurements are being used to optimize drying schedules.
- Changes to kiln schedules include the optimal time for air drying, and adjustments to sensors and computer-based control systems.
- Two-year trials are underway in test kilns and dryers at the facilities of the industrial partners.
- The industrial partners in this project will benefit from the participation in the effort and the immediate transfer of information to them as the work progresses
- The project's final results will be disseminated through conferences, publications, and control tables to help the forest products industry improve its use of energy.



PROJECT PARTNERS

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